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1888, certainly exceeded 8,000,000 gross tons, instead of the estimates of 6,808,386 and 6,688,744 tons, respectively, obtained by the old method.

We have annually, for several years, consumed more iron and steel than any of the great European countries. The *per capita* consumption of iron and steel by the United States is also greater than that of any other country. In 1887 our consumption of finished iron and steel exceeded 300 pounds *per capita*, estimating our population for that year at 60,000,000. In 1888, however, our *per capita* consumption declined to probably 285 pounds.

Another new departure is the determination of the wire-rod production of the United States, which has never before been definitely ascertained. In 1888 this was 313,341 net tons. Pennsylvania and Ohio each made a little over one third of the total production, and Massachusetts made the larger part of the remainder.



UNIFORM RAILWAY STATISTICS.

On March 5-7, 1889, a conference of members of State Railroad Commissions and certain officers of the American Railway Accounting Association, was held at Washington, to discuss the subjects of railway statistics, classification of freight, railway legislation, and railway construction. At this meeting Henry C. Adams, Statistician of the Interstate Commerce Commission, read a paper on Uniform Railway Statistics, which is published in a report of the proceedings, issued by the Interstate Commerce Commission. This paper is substantially as follows:—

In the circular of January 31, inviting the Railway Commissioners of the various States to participate in a general conference, the subject of uniform railway statistics was given the most prominent place among the topics to be discussed. This probably was by design on the part of those who arranged the programme, and the readiness with which the invitation was accepted may be taken as indicating some degree of interest in this subject. My own experience in the

practical work of compiling statistics has not been extended ; it has, however, been ample to convince me that without a common understanding on the part of those engaged in this line of investigation, results cannot be expected at all commensurate with energy expended. Uniformity of method is a matter of such vital importance to the satisfactory performance of the tasks which government has entrusted to the hands of the several railway commissions that this convention ought to be unwilling to separate until some definite plan has been adopted for harmonious and co-operative statistical work. The few words I have to say will be directed by this purpose.

Permit me, then, at the outset to call your attention to certain advantages sure to arise from the adoption of uniform methods of collecting and presenting railway statistics in the United States. These advantages are of three sorts. In the first place, uniformity of procedure presents the only feasible plan by which accuracy of conclusions may be ensured. In the second place, unless statistics are compiled according to uniform rules it is impossible to use conclusions arising from them for comparative study. And, lastly, it will be very difficult to arrive at complete statistics unless the State Commissioners are willing to co-operate with the statistical department of the Interstate Commerce Commission. Let us look at these points a little in detail.

The first claim for a uniform rule in statistical inquiry is that it presents the only feasible plan by which accuracy in conclusions may be ensured. Consider, by way of illustration, the question of railway mileage. Here, certainly, one would say, is a question of simple measurements, and it is the fault of the statistician if his conclusions are not correct. Without denying the responsibility of the statistician, a moment's consideration will show the question of mileage to be less simple than it at first appears. A great railway corporation is a very complex affair ; it is divided into many departments for administration and control, and it is of considerable importance to the statistician which department furnishes the facts to be compiled. Thus the figures on mileage may come from the auditor or from the engineer, and it is by no means certain that the returns made by the chief engineer will be the same as those made by the financial officer. Discrepancies arising from this cause have so frequently occurred in the experience of our office that they have ceased to be the occasion of surprise.

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But a more serious source of error presents itself when we notice that the difference between length of line operated and length of line owned is not always kept in view by the officers of roads making reports. Of course the total mileage in the country must equal the sum of the miles of line owned by each and every corporation in the country. Should any company report as mileage owned, mileage which it operates, or controls, there would arise a duplication which

would vitiate all results. This is very simple and clear when thus presented; and, so far as I am aware, all the reports of the State Railway Commissions recognize the danger, and endeavor to guard against it; but your experience must be very different from that of this office if you have succeeded in satisfying yourselves that your figures represent things exactly as they are. In the first place, trackage rights present a class of embarrassing questions. It is not possible to be sure in all cases that a strip of road used by several companies is not included in the total returned by each. We have quite accidentally discovered a few cases of erroneous returns of this sort by observing in the expense account an item charged as rentals for trackage rights, although no trackage rights were mentioned in mileage operated. Similar to this is the case of several companies owning jointly a strip of track; one makes return of its portion as part of its mileage owned, while the report of the other road makes no mention of the fact whatever. Another source of embarrassment presents itself in connection with "proprietary" relationships existing between operating and subsidiary roads. Expressions like "proprietary ownership" or "ownership through control of majority of stock," are by no means infrequent in the reports made by the various roads, a fact which gives rise to some uncertainty as to the exact meaning of the figures returned under the heading, "length of line owned." It is very easy for mileage to be duplicated by crediting to the roads which claim "proprietary ownership," or "virtual ownership" mileage already accounted for as the property of the absorbed company.

One word more on this question of mileage. A common way of estimating the total railway mileage of the United States is to take from the reports of the State Commissions the mileage of each State. Nothing could be simpler, assuming the several amounts thus summarized to be correct. But on this point, also, the experience of this office is not such as to warrant perfect reliance upon such figures. Turning to page 27 of our Form, you will notice that each company is expected to apportion its mileage to the several States through which its line runs. What is wanted here is the assignment of "Total Mileage" as returned by operating roads, to the several States. It has been found necessary to return for correction more than one hundred books, because some other figure than total mileage was accepted as the basis of apportionment. Assuming that the State Commissions have met with similar difficulty, there is no guarantee, except in the care exercised by the Commissioners, that the sum of the mileage thus apportioned will accurately represent the length of line in the United States, or that the total mileage for the United States, so far as it is computed for State Reports, will be absolutely correct.

In what way is it possible to overcome the difficulties thus suggested, and arrive at conclusions worthy of confidence? It is no

answer to say that care should be exercised by those who compile statistics. That goes without saying. What is needed is some proof of the accuracy of conclusions; some test so that we may know when adequate care has been exercised. Now the only test of accuracy in the compilation of statistics is harmony of results when those results have been arrived at by different methods or by different persons using the same methods. Such a test, however, cannot be applied unless there is general uniformity in statistical methods; that is to say, uniformity as to the primal facts gathered, uniformity as to the meaning of all questions put to the railway companies, and uniformity as to the theory on which the items that make up totals are classified. This, then, is the first argument for the adoption of uniform methods of statistical inquiry by the State Commissions and the Interstate Commerce Commission. It is essential in order to provide a test for the accuracy of facts. It will be a most fortunate thing for railway statistics in the United States if this convention shall adopt a scheme by which the conclusions of the State and Federal railway commissions may be checked against each other.

The second advantage of uniformity in statistical inquiry, as above suggested, springs from the fact that statistics yield their best results when made the basis of comparative study, and that without uniformity in method no comparison is possible. This point might be presented at length by discussing the theory of statistics, but I choose rather to bring it before you by means of two or three practical illustrations.

One of the important questions in railway economy pertains to the amount of capital stock and bonds that are issued per mile of line. The question of fair rates is more intimately connected with the amount of property per mile than with any other one element that enters into the problem. But, you will say, this is a simple matter. It is only necessary to divide the total mileage by the total of bonds and stocks, and you will get the average debt burden per mile of line. This sounds reasonable, but it may be doubted if conclusions so obtained would be of much real value. One of the rules of statistical science is that classification of facts must always precede their compilation or reduction, otherwise the averages arrived at will be typical of nothing in particular. An average that does not spring from homogeneous facts cannot be accepted as a normal measure of the forces responsible for them, and cannot, in consequence, serve as the basis for comparisons for cases which show widely-varying results. But the chief practical aim of statistics is to discover a normal rule so that abnormal results will quickly arrest attention. It thus appears that an average made without due regard to classification of the facts which it assumes to represent is utterly worthless for purposes of investigation. Applying, now, this general conclusion to the question in hand, it follows that considerable attention must be given to the classification of the conditions under which railways may be built, before an average of stocks or bonds issued per mile of line can have

any pertinency for practical discussion. It is on this point of classification that uniformity must be observed by all bureaus of railway statistics, since comparison would otherwise be impossible. So clear a proposition needs no further comment.

But there is another reason also why those who control railway statistics should come to some common understanding with regard to the per-mileage estimate of stock and debt, for the truth is there are several ways in which this estimate can be made. Upon page 7 of the blank Form issued from this office the railroads were requested to apportion their stock, their funded debt, and their floating debt on the basis of mileage. The various ways in which this could be done, and yet preserve the letter of the requirement, was to me a very embarrassing revelation, although, without doubt, each auditor made the returns according to the method of book-keeping in his own office, or as he thought best fitted to present the peculiar conditions of his road. Some apportioned bonds and stock on the basis of mileage owned or operated, while debt was apportioned to the length of line mortgaged as security for the debt. In some cases the amount of stock owned by a proprietary company in a subsidiary road was included in the total stock apportioned, a method of procedure which would of course lead either to duplication of stock or to a deficiency of stock, according to the report of the subsidiary road. Now, assuming that our experience with this question is typical of the experience of other offices engaged in similar work, is it not clear that a comparison of the amount of stock and debt per mile of line in one state with the corresponding item in another state may be wholly misleading? Each office undertakes to adjust the discrepancies according to rules which itself adopts, and a comparison of bonded debt between various roads in the same state may lead to valid conclusions; but when this comparison passes beyond state lines there is no adequate guarantee that the results compared represent the same classification of facts. Manifestly, here is a point with regard to which a common rule for the compilation of averages is essential for valid conclusions.

Another illustration of the fact that uniformity in method of inquiry, or what amounts to the same thing, harmony in classification of facts inquired into, is necessary for purpose of comparative study, may not be out of place. A prominent railroad paper, commenting on the preliminary report issued from this office, called attention to the small percentage of railway capital assigned as circulating capital. The figures of this report show that about three per cent of the total of capital devoted to the railway industry exists outside of fixed investments or funded debt, while, says the writer in the paper referred to, the true amount is over five per cent. In all probability this difference does not pertain to the fundamental facts in the case, but arises from a different method of classification. The criticisms of this paper, which were friendly and therefore helpful, led me to look into the reports of the various state commissions, to see if there was

any uniformity in the management of this item of unfunded debt. The result of that inquiry is instructive, for it shows that this item did not in any two cases represent exactly the same thing, and therefore that the totals of circulating capital, as returned in these reports, are useless for purposes of comparative study. I repeat, then, it is essential that we come to some common understanding as to the meaning of the phrases we employ.

The third consideration, favoring harmony of action in statistical inquiry between the various railway commissions, is that such action is necessary, or at least highly desirable, in order to arrive at a complete and comprehensive presentation of facts. The truth of this claim rests in part on the peculiar relation that exists between federal and state authority, and in part upon the nature of the questions to be investigated. There are a few lines of inquiry, essential to a comprehensive portrayal of inland traffic, which lie outside the authority conferred by Congress upon the Commission, but over which the commissions of the states have undoubted legal control. The embarrassment experienced on this account would be greatly diminished should all interested in railway statistics come to a common understanding as to the form of inquiry to be pursued; since, in that case, it would be possible for the Interstate Commerce Commission to supplement its facts by facts gathered under the supervision of the State Commissions. Provided only the matter appears of sufficient importance, much more complete and satisfactory results may be attained for all concerned by co-operative work between the various commissions than by isolated and disjointed inquiry. Or if we consider the nature of the question to be investigated, the same conclusion is reached. There are many things which it is impossible to investigate from a distance, because they call for detailed knowledge of all the facts in the case. An illustration will show what is meant. It is of some importance that the entire amount of property devoted to the business of inland transportation should be known. It is incorrect to assume that this property is truly represented by railway bonds and stocks; for, as a matter of fact, there are, in addition to interest and dividends, quite a number of items charged to operating expenses, or to fixed charges, that are payments on property devoted to inland traffic. Consider for a moment the number of independent bridge companies, depot companies, terminal facilities, elevator and storage companies, stock-yard companies, and the like, all of which are supported out of payments made for transportation, and all of which should be accounted for in complete statistics of property devoted to inland traffic. Without doubt it would be possible for a single Bureau to make up a complete list of this property, but such a task would be greatly facilitated by the assistance of the State Railway Commissions. Similar conclusions would be arrived at if we were to consider car-trust obligations, a form of railway indebtedness most confusing on account of the great variety of contracts that go under

that name; or certificates issued by receivers of insolvent roads, which present many difficulties to the statistician.

In matters of this sort, co-operative inquiry, conducted according to some common plan, would remove obstacles which otherwise seem almost insurmountable. The chief benefit might perhaps accrue to the Interstate Commerce Commission, charged as it is with the duty of collecting complete statistics for the entire country, but it by no means follows that the service would be wholly one-sided. The State Railway Commissions would certainly be assisted in the performance of their various duties by such co-operation as is here suggested. This railway problem is in no sense of the word a local problem. Only a few cases present themselves to the consideration of commissions which do not demand a somewhat comprehensive view of the facts of railway management. It would be of great advantage to the State Commissions to be able to compare the items that go to make up the totals of property devoted to traffic in their own state with corresponding totals in other states, a comparison that is out of the question unless the investigations of all proceed according to the same plan. It is then the results that must flow from assistance rendered by the State Commissions which will compensate them for the interest they show in the broad work undertaken by the statistical service of the Interstate Commerce Commission.

Assuming the need of co-operative work according to some uniform plan is a thing to be desired, what steps are to be taken to attain this end? Before making definite proposals it may be well to inquire to what extent railway statistics now recognize a common purpose. In undertaking to answer this question I first consulted the laws of the various states by which railway commissions are authorized; and the impression left by the study was that, so far as law is concerned, the liberty granted in statistical matters, as well as the specified duties imposed upon the State Commissioners, provides ample opportunity for harmonious methods of procedure. The laws of the various states seem to be drawn on the same general model.

A better way, however, of discovering the degree of statistical harmony that exists is to compare the statistical work put forth in the State Reports. The law shows what the Commissioners have the liberty of doing; the reports show what under the law they have chosen to do. Now a superficial examination of these reports would leave the impression that there is divergence at every point, and that it would be impossible to use them for purposes of comparative study; but a little more care discloses the fact that the differences pertain to method of presentation, while the data given, as well as the fundamental idea that has directed its collection, are about the same in all cases. This is a most encouraging disclosure, for it shows that the groundwork of harmonious investigation has already been laid, and that it is only necessary for us to adjust the details of the several plans to some common idea.

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It need hardly be said that a system of statistics which fails to recognize some common unit of measurement for the forces studied can serve no rational purpose. Now the unit adopted by the best authorities in railway statistics is the ton-mileage or passenger-mileage unit, and it is a matter for congratulation that all of the State Commissions, with two exceptions, reduce the traffic figures which they present to this common basis; and in these two cases this common basis of measurement will undoubtedly be adopted when their statistical work is developed sufficiently to allow of general reductions. In this respect American Railway Statistics are in advance of those of England, which still accept train-mileage as the unit of measurement. It seems, then, that the problem of establishing uniformity of railway statistics in the United States is by no means a difficult one. The first steps in that direction have already been taken, and it is only necessary to go with care over certain matters of detail so as to come to a common understanding as to the exact meaning of such inquiries as are made, and adopt common theories for the classification of items. Permit me to suggest one or two points that call for immediate attention.

The first point that should be considered pertains to the date adopted for the close of the fiscal year. As matters now stand, ten of the Commissions accept June 30 as the close of the fiscal year; six states have accepted September 30, five states have adopted December 31, one state calls for quarterly, and one for monthly, returns.

Now, if the statistical results of the State Commissions, and of the Interstate Commerce Commission, are to be used as checks each against the other, it is essential that the financial year adopted as the basis of returns should be the same for all. There are certain advantages in accepting June 30 as the date for closing books, but as this question has received so much attention of late, I will do no more at this time than to suggest it for yet further consideration.

Another topic that should be considered by this convention pertains to the classification of operating expenses. There are now twelve states that have adopted what is known as "The Saratoga Classification," which, as you are aware, was drawn up by a conference of State Railroad Commissioners in Saratoga in June, 1879. So far as I am aware, no general complaint has ever been urged by the auditors of the various roads with regard to this classification. It seems to be as simple as the subject admits of. Many auditors have, during the last year, adjusted their accounts to its requirements, and it is believed that formal action by this convention, favoring this classification, is all that is needed to lead to its universal adoption. Certainly if this be the case, arguments in favor of such a step are not needed. It is absolutely essential for attaining the best results, that operating expenses be reduced to uniform classification.

In close connection with classification of operating expenses stands

the division of expenditures between "expenses of operation" and "fixed charges." The rule adopted in this office is to assign taxes to fixed charges, and for all general problems in railway economy there are many reasons favoring such a classification. But the reports of the states show no uniformity on this subject. In some cases taxes are classed as fixed charges; in some they are included in operating expenses, while other reports keep them separate from both items. It would add greatly to the ease with which these reports could be used, should some uniform rule of treatment be adopted. Another question deserving consideration pertains to the rule for estimating the deterioration of railway property through wear and tear. There seems to be almost total absence of uniform action on this point, while many roads apparently omit this altogether from their accounts; and yet, when we consider the ease with which facts of this nature may be collected, provided only a proper method of book-keeping be adopted by the railways, and when we notice what direct bearing the rate of wear on rolling stock has on questions of railway economy, the omission is a little surprising. The reverse of this question is that of betterments and improvements. A great deal of attention has been given to the proper method of accounting for moneys expended in permanent improvements or applied to reduction of indebtedness; and, as is well known, the question involved is one that is decided differently by different states and railway administrators. So far as a railway is concerned, it depends largely upon the financial policy adopted whether permanent improvements are charged to operating expenses or to the improvement account. The public certainly ought to make no complaint if the latter method is adopted. At the same time, when the use to be made of statistics is held in mind, accounts should be kept so as to allow of some degree of uniformity as to the meaning of operating expenses. This is a difficult matter to adjust, and should receive the careful attention of those interested in railway statistics.

It is unnecessary to follow this subject further, or to suggest more of the topics that call for detailed discussion. There can be no question of the desirableness of uniform railway statistics in the United States, and, as has been discovered, the degree of uniformity that now exists is such as to encourage further steps in the same direction. It only remains for the members of the Convention to consider with care which steps should be taken first, and in what manner the desired end may be most easily attained.